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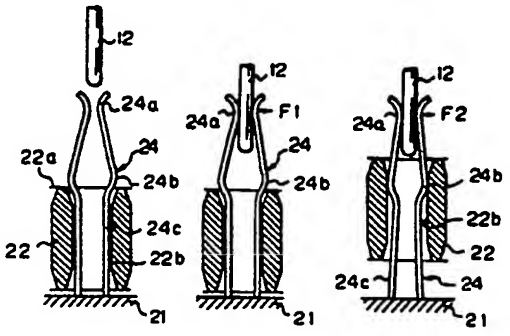
(54) An electrical connector.

(57) An electrical connector includes a plug (10) having a number of contact pins (12) and a jack (15) having a corresponding number of receptacle contacts (24). Each of the receptacle contacts (24) has a parallel portion (24c) and a widened portion (24b). A contact pressing member (22) having partition walls (22b) is movable so that when the contact pressing member (22) is in a first position (Figure 8A), the partition walls (22b) are positioned adjacent the parallel portions (24c) of the receptacle contacts (24) to allow an easy insertion of the contact pins (12) (Figure 8B) and, when the contact pressing member is moved to a second position (Figure 8C), the partition walls (22b) are moved to the widened portions (24b) of the receptacle contacts (24) so that they urge the widened portions (22b) together and, therefore, the receptacle contacts (24) are pressed into tight contact with the contact pins (12).

Fig.8A Fig.8B Fig.8C



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An Electrical Connector

This invention relates to a connector used in the electric or electronic fields and, more particularly, to an electrical connector comprising a plug assembly having a large number of contact pins and a jack assembly having a correspondingly large number of receptacle contacts.

In the recent years, electronic instruments such as computers have become very sophisticated, and accordingly, the number of their output terminals has greatly increased. Therefore, a connector having a large number of pins or contacts is required and such a connector must be handled by an operator, and stably connected to a corresponding connector in such a manner that only a small force is necessary when one part of the connector is engaged with or disengaged from the other part.

An electrical connector known in the prior art comprises a plug assembly having a large number of contact pins and a jack assembly having a corresponding number of receptacle contacts. Namely, the plug comprises a large number of contact pins regularly arranged and rigidly secured to a board to constitute a pin array, and the jack assembly comprises a large number of receptacle contacts, each usually having a pair of contact portions, and a molded body having a large number of compartments and guide slots corresponding to the array of contact pins. The pairs of contact portions of the receptacle contacts are accommodated in the compartments, and when the plug is engaged with the jack the contact pins of the plug are inserted through the respective guide slots into the compartments, i.e., the gaps formed between the pairs of contact portions, in such a manner that the contact pin widens the gap of the contact portions and comes into sliding contact with the contact portions.

However, a conventional connector as mentioned above has several drawbacks, for example, the force for inserting the contact pins into the jack is also used for widening the gaps between the pairs of contact portions and therefore, as the number of contact pins is increased, and plug insertion force also increases. This plug insertion force is exerted directly on the contact pins and receptacle contacts, i.e., on the plug and jack assemblies so that the parts and materials constituting these assemblies must be strong. In addition, if the number of contact pins is further increased, it becomes difficult uniformly to apply a large plug insertion force at all areas of the jack or plug assemblies. This also increases the possibility of damage to or deformation of the contact pins or receptacle contacts when the two parts are tilted.

According to this invention an electrical connector comprises

a) a plug assembly having a number of contact pins;

b) a jack assembly including:

a corresponding number of resilient receptacle contacts, each of the receptacle contacts having a gap at one end into which, in use, the corresponding contact pin is inserted, so that the contact pins simultaneously come into electrical contact with the receptacle contacts, the receptacle contacts having parallel portions in which their outer surfaces are parallel and a widened portion in which the width between their outer surfaces is greater than that in the parallel portion, and

a contact pressing member having partition walls and being movable between a first position and a second position, in the first position, the partition walls are located adjacent the parallel portions of the receptacle contacts to allow easy insertion of the contact pins and in the second position, the partition walls engage the widened portions of the receptacle contacts and urge them together so that the receptacle contacts are pressed into tight contact with the contact pins; and,

c) means for moving the contact pressing member between its first and second positions.

Thus, a multiple pin and receptacle contact type electrical connector is obtained in which the plug insertion force is significantly reduced and, therefore, a connecting operation can be easily performed, and in the connected state, a large and uniform contact force is maintained between the pin contacts and the receptacle contacts.

Preferably

a) the plug assembly includes a board with the number of contact pins regularly arranged on it; and,

b) the jack assembly includes a mother board and a plurality of jack modules regularly arranged on the mother board; each of the jack modules comprising:

a housing fixed on to the mother board and housing a number of the receptacle contacts arranged in a regular array and projecting from it, and the contact pressing member has its partition walls surrounding the projecting receptacle contacts and being movably mounted with respect to the housing.

Preferably each of the contact pressing members is provided at a side wall with an inclined guide groove and the moving means comprises a plurality of slidably mounted sliding members, each of the sliding members having projections which are engaged with the inclined guide grooves of the contact pressing members, whereby the contact

pressing members are moved up and down by a sliding movement of the sliding members. In this case, all or a group of the jack modules are connected simultaneously by the operating means, and after the insertion of the jack assembly, this operating means can be removed so that the provision of a particular space for the operation means is unnecessary.

Particular embodiments of electrical connectors in accordance with this invention will now be described with reference to the accompanying drawings; in which:-

Figure 1 is a perspective view of a first embodiment;

Figure 2 is a perspective view of a jack assembly;

Figure 3 is a perspective view of a jack module:

Figure 4 is a perspective view of a receptacle contact;

Figures 5A, 5B, and 5C are perspective views of housing, a contact pressing member, and a guide member constituting a jack module, respectively:

Figure 6 is a partial cross-sectional view of the electrical connector shown in Figure 1;

Figure 7 is a partial side view, shown in cross-section illustrating a means for causing up and down movement of the contact pressing member in the first embodiment;

Figures 8A, 8B and 8C are schematic views for explaining the operation of the connector of this invention;

Figure 9 is a perspective view of a jack assembly in another embodiment of this invention;

Figure 10 is an enlarged perspective view of a portion X in Figure 9;

Figure 11 is a schematic view for explaining an operation of a cam lever used in the embodiment shown in Figures 9 and 10;

Figure 12 is a perspective view of jack modules and sliding members in still another embodiment of this invention;

Figure 13 is a sechematic view of a jack assembly in the embodiment shown in Figure 12; and,

Figure 14 is an enlarged perspective view of a portion XIV in Figure 13.

Referring now to Fig. 1, a plug assembly 10 comprises a board 11 to which a large number of contact pins 12 are rigidly secured. These pins 12 are regularly arranged and constitute a pin array. A jack assembly 15 comprises a plurality of jack modules 20 regularly arranged and fixed on a mother board 16 (Fig. 2). Each module 20 (Fig. 3) comprises a housing 21, a contact pressing member 22, and a pin guide 23, which are molded of plastic, and a plurality of receptacle contacts 24.

Each receptacle contact 24 (Fig. 4) consists of a relatively long metal piece having a pair of leaves extending upward from the housing 21, and comprising pairs of contact portions 24a, widened portions 24b, and parallel straight portions 24c, a U-shaped base portion 24d and a lower extending portion 24e. The contact portions 24a opened to the top are slightly diverged to facilitate the insertion of the contact pin 12, and the gap between the widened portions 24b is wider than the gap between this parallel straight portions 24c.

The housing 21 (Fig. 5A) fixed on the mother board 16 has a plurality of regularly arranged compartments 21a separated by partition walls 21b (Fig. 7). The receptacle contact 24 is inserted into the compartment 21a in such a manner that the U-shaped base portions 24d is fixed in the compartments 21a, whereby the lower portion 24e extends downward from the housing 21 and the upper portions 24a, 24b, and 24c extend upward therefrom. The housing 21 is provided at the both sides thereof with a pair of vertical columns 21c having vertical recesses 21d, with two pairs of hooks 21e, at the front and rear ends thereof and two pair of horizontal guide grooves 21f at both sides thereof.

The contact pressing member 22 (Fig. 5B) has an upper opening 22a and a plurality of regularly arranged holes 22b corresponding to the compartments 21a of the housing 21 for receiving the receptacle contacts 24. The contact pressing member 22 is provided at both sides thereof with a pair of vertical grooves 22c which fit the vertical columns 21c of the housing 21, respectively, so that the contact pressing member 22 is vertically slidable up and down the housing 21. When the contact pressing member 22 is moved down, the holes 22b (partition walls 22e define these holes 22b) are positioned at the parallel straight portions 24c of the receptacle contact 24. On the other hand, when the contact pressing member 22 is pulled up, the holes 22a (partition walls 22e) are positioned at the widened portions 24b of the receptacle contact 24 so as to narrow the gap between the pair of contact portions 24a. When the contact pressing member 22 is in the lower position, the gap between the pair of contact portions 24a is slightly smaller than the diameter of the contact pin 12, and accordingly, a contact force F_1 for inserting the contact pin 12 at this position is far smaller than a contact force F_2 in which the gap between the contact portions 24a is narrowed by moving the contact pressing member 22 upward ($F_1 \ll F_2$). The contact pressing member 22 is provided at both sides thereof with two pairs of cam grooves 22d which are inclined with respect to the horizontal guide groove 21f of the housing 21.

The contact pin guide 23 (Fig. 5C) also has a plurality of regularly arranged holes 23a corre-

sponding to the holes 22a of the contact pressing member 22 into which the contact pins 12 of the plug assembly 10 can be inserted. The contact pin guide 23 is provided at both sides thereof with a pair of vertical projections 23b which fit into the vertical recesses 21d of the housing 21 and, at the front and rear ends thereof, with two pairs of jaws 23c which engage with the hooks 21e of the housing 21, so that the guide member 23 is thus fixedly attached to the housing 21.

The means 40 for moving the contact pressing member 22 up and down will now be described with reference to Figs. 1, 6, and 7. Movably arranged in each gap 17 formed between the longitudinal rows of jack modules 20, are a longitudinal sliding members 30 having a plurality of upper and lower projections 31 and 32, which are engaged with the cam grooves 22d of the contact pressing member 22 and the guide grooves 21f of the housing 21, respectively. These sliding members 30 are also arranged along the side faces of the left-and rightmost rows of the jack modules 20, respectively. Accordingly, since the guide grooves 21f are straight but the cam grooves 22d are gradually inclined downward to the front, when the sliding members 30 are moved forward, the contact pressing member 22 is moved upward.

Each sliding member 30 is provided at the rear end thereof with open hole 33, and in the vicinity thereof, a bearing block 41 having a bearing groove 42 is fixed on the mother board 16. A tool 43 having a protrusion 44 insertable into the hole 33 of the sliding member 30 and a pair of legs 45 engageable with the bearing grooves 42 of the adjacent two blocks 41 is provided, and therefore, when the plug assembly 10 is to be inserted into the jack assembly 15, the tool 43 is engaged with the blocks 41 and the protrusion 44 is inserted into the hole 33, so that the sliding members 39 is slidably moved.

The operation of the connector of this invention will now be described with reference to Figs. 8A, 8B, and 8C. Before the insertion of the contact pins 12, the sliding members 30 are in the rearward position and, therefore, the upper projections 31 are positioned at an upper portion of the inclined cam grooves 22d, so that the contact pressing member 22 is in the lower position, the holes 22b (partition wall 22e) thereof are fitted only on the parallel portions 24c of the receptacle contacts 24, and the wide portions 24b of the receptacle contacts 24 freely lie within the openings 22a of the contact pressing member 22, as shown in Fig. 8A.

In this state, the plug assembly 10 is lowered in such a manner that the plug contact pins 12 are inserted through the holes 23a of contact pin guides 23 into the jack modules 20, and then each contact pin 12 is inserted into the gap between the pair of contact portions 24a of the receptacle contacts 24, as shown in Fig. 8B. In this state, the pair of receptacle contacts (including portions 24a, 24b, and 24c) are supported, in a cantilever fashion, on the housing 21 and, therefore, the contact force F (force exerted on the contact pin 12) is so small that a large number of contact pins 12 can be easily, simultaneously inserted into the jack modules 20 with a relatively small insertion force and slidingly moved along the contact portions 24a, to thereby effectively rid the contact pins 12 and receptacle contacts 24 of any contamination thereon. Thus, an effective cleaning can be attained by a slight friction exerted between the contact pin 12 and the receptacle contact 24 by the contact force F_1.

After the insertion of the plug assembly 10, the tool 43 (Fig. 7) is set on the bearing blocks 41 to move the sliding member 30 forward, and thus the upper projection 31 thereof is brought into contact with a lower portion of the inclined cam groove 22d, so that the contact pressing member 22 is moved to the upper position, as shown in Fig. 8C. Therefore, the hole 22b (partition wall 22e) moves upward to the widened portions 24b of the contact 24 and narrows the gap therebetween, so that the top contact portions 24a are strongly pushed (force F_2) against the plug contact pin 12 and brought into firm contact with the contact pin 12, and thus the plug insertion is completed. Thereafter, the contact pressing member 22 is kept at the upper position, and thus the firm contact between the receptacle contact 24 and the plug contact pin 12 is maintained.

When the plug assembly 10 is to be disengaged from the jack modules 20, the sliding member 30 is first moved backward to lower the contact pressing member 22, and then the plug assembly 10 is raised from the jack assembly 15 in an opposite manner as to that described above, for the engagement of the plug assembly 10.

Another embodiment of the means 50 for moving the sliding members 30 is shown in Figs. 9, 10, and 11. In this embodiment, the sliding member 30 has a groove 34 at the rear end thereof and, in the vicinity thereof, a cam lever 51, provided for each adjacent two of the slide members 30, is pivotably mounted by a shaft 52 on adjacent bearing blocks 53, which are arranged between the cam levers 51 and fixed on the mother board 16. The cam lever 51 is provided at the free end thereof with a pair of shafts 54 and 55 projecting from both sides thereof to engage with the grooves 34 of two adjacent sliding members 30, respectively. Each of the grooves 34 has a U-shaped, semicircular cross-section and, on the other hand, each of the shafts 54 and 55 has a cylindrical, circular cross-section.

The upper ends of the cam levers 51 are

rigidly connected by, for example, bolts 56, to a common connecting bar 57 extending in parallel to the shaft 52. The connecting bar 57 has two tool insert projections 58 extending in the direction opposite to that of the cam levers 51. Two operating tools 59 can be detachably fitted to the projections 58 so that, when the operating tools 59 are pulled in the direction indicated by arrows in Fig. 9, the cam levers 51 are pivotably moved in the clockwise direction (Fig. 11) to move the shafts 54 and 55 forward, and therefore, all of the sliding members 30 are simultaneously moved forward to raise the contact pressing members 22 of the jack modules 20.

According to this embodiment, a dimension-(width) of the groove 34 may be smaller than that of the hole 33(Fig. 7) in the previous embodiments and, therefore, an operating area S may be minimized, since the cylindrical shaft 54, 55 is engaged with the semicircular groove 34. That is, in Fig. 11, when the cam lever 51 is pivotably moved about the shaft 52 in the direction indicated by an arrow, the shaft 54, 55 pushes a wall of the groove 34 and is allowed to turn in the same groove 34. This means that the width of the grrove 34 is sufficient to be very slightly larger than the diameter of the shaft 54, 55 so that the latter can freely turns in the groove 34. Contrary to this, in the embodiment of Fig. 7, the width of the hole 33 must be larger than a distance corresponding to the stroke of the sliding member 30 and, therefore, a larger operating area is required.

Figures 12, 13, and 14 illustrate still another embodiment for moving the contact pressing member 22 up and down. In this embodiment, movably arranged at both sides of the longitudinal rows of the jack modules 20 are pairs of longitudinal sliding members 60a and 60b having a plurality of upper and lower projections 61 and 62 on the inner sides thereof. These projections 61 and 62 are engaged with the cam grooves 22d of the contact pressing member 22 and guide grooves 21f of the housing 21, respectively, in the same manner as in the previous embodiment.

Each pair of sliding members 60a is connected at the rear end thereof to a connecting member 63 having a top opening groove 64 at the rear end thereof, and in the vicinity thereof, a cam lever 65 (Fig. 14), provided for the two adjacent connecting members 63, is pivotably mounted by a shaft 66 on a bearing block 68 (Fig. 13) fixed on the mother board 16 (not shown in Fig. 13). The cam lever 65 is provided at the free end thereof with a pair of shafts 67 projecting from both sides thereof to engage with the grooves 64 of the two adjacent connecting members 63, respectively.

The upper end of each cam lever 65 has a threaded hole 69 to which an operating tool 70 having a threaded projection at one end thereof can be detachably attached, so that when the operating tool 70 is pulled in the direction indicated by an arrow in Fig. 13, the cam lever 65 is pivotably moved independently of the other cam levers 65. Therefore, two pairs of the sliding members 60a and 60b are simultaneously moved forward to raise the contact members 22 of the two rows of jack modules 20. Thus, the operating tool 70 can be used, in turn, for the subsequent cam levers 65 so that two pairs of sliding members 60a and 60b are moved each time.

Claims

1. An electrical connector comprising:

a) a plug assembly (10) having a number of contact pins (12);

b) a jack assembly (15) including:

a corresponding number of resilient receptacle contacts (24), each of the receptacle contacts (24) having a gap at one end (24a) into which, in use, the corresponding contact pin (12) is inserted, so that the contact pins (12) simultaneously come into electrical contact with the receptacle contacts (24), the receptacle contacts (24) having parallel portions (24c) in which their outer surfaces are parallel and a widened portion (24b) in which the width between their outer surfaces is greater than that in the parallel portion, and

a contact pressing member (22) having partition walls (22b) and being movable between a first position and a second position, in the first position, the partition walls (22b) are located adjacent the parallel portions (24c) of the receptacle contacts (24) to allow easy insertion of the contact pins (12) and in the second position, the partition walls (22b) engage the widened portions of the receptacle contacts (24b) and urge them together so that the receptacle contacts (24) are pressed into tight contact with the contact pins (12); and,

c) means (21f, 22d, 30, 31, 32) for moving the contact pressing member (23) between its first and second positions.

2. A connector according to claim 1, wherein each of the receptacle contacts (24) comprises a pair of resilient leaves arranged face-to-face with the gap between them.

3. An electrical connector according to claim 1 or 2, wherein:

a) the plug assembly includes a board (11) with the number of contact pins (12) regularly arranged on it; and,

b) the jack assembly (15) includes a mother board (16) and a plurality of jack modules (20) regularly arranged on the mother board (16); each of the jack modules (20) comprising:

a housing (21) fixed on to the mother board (16) and housing a number of the receptacle contacts (24) arranged in a regular array and projecting from it, and the contact pressing member (22) has its partition walls (22b) surrounding the projecting receptacle contacts (24) and being movably mounted with respect to the housing (21).

4. A connector according to claim 3, wherein the housing (21) includes means (21c) for slidably guiding the contact pressing member (22) as it moves between its first position and its second position.

5. A connector according to claim 3 or 4, wherein the widened portion (24b) of the receptacle contacts (24) is intermediate the parallel portion (24c) and the one end (24a), and which also includes a contact pin (23) guide fixed to the housing (21) and having a number of guide holes (23a) in locations corresponding to those of the contact pins (12) so that in use, the contact pins (12) are initially inserted through the guide holes (23a) and then brought into contact with the receptacle contacts (24).

6. A connector according to claim 3, 4, or 6, wherein each of the contact pressing members (22) is provided at a side wall of it with an inclined guide groove (22a) and the moving means comprises a plurality of slidably mounted sliding members (30), each of the sliding members (30) having projections (31) which are engaged with the inclined guide grooves (22d) of the contact pressing members (22), whereby the contact pressing members (22) are moved up and down by a sliding movement of the sliding members (30).

7. A connector according to claim 6, wherein the sliding members (30) are slidably disposed in a gap between two adjacent jack modules (20) and provided with projections (31) on both sides, so that the projections (31) are engaged with inclined guide grooves (22d) of the two adjacent jack modules (20).

8. A connector according to claim 6 or 7, wherein each of the contact pressing members (22) has inclined guide grooves (22d) in both opposite side walls, and the moving means comprises pairs of sliding members (30) each pair of the sliding members (30) having projections (31) which engage with the inclined guide grooves (22d) at both sides of the contact pressing members (22).

9. A connector according to claim 6, 7 or 8, also including a plurality of cam levers (43) pivotably mounted on the mother board (16), each of the cam levers (43) having one end (44) engaged with one or more of the sliding members (30); and,

a detachable operating means (59) for pivotally moving one or more of the cam levers (43).

10. A connector according to claim 9, wherein the cam levers (51) are connected to one another by a common bar (57) so that the plurality of cam levers (51) are pivotably moved simultaneously and the operating means (59) is detachably attached to the common bar (57), whereby the contact pressing members (22) of all of the jack modules (20) are moved as a single operation.

11. A connector according to claim 9 when dependent upon claim 8, wherein a plurality of pairs of sliding members (60a and b) are slidably disposed along both sides of the jack modules (20), each pair of the sliding members (60) having one end engaged with one of the cam levers (65) and the operating means (70) is detachably attached to each individual cam lever (64) whereby the contact pressing members (22) of one row of the jack modules (20) are moved in a single operation.

12. A connector according to claim 9, 10 or 11, wherein the cam lever (51,65) is provided at the one end with at least one shaft (54, 67) having a circular cross-section and extending parallel to an axis about which the cam lever (57, 65) is pivoted, the sliding member (30, 60) having a U-shaped groove (34, 64) with semicircular cross-section, the shaft (54, 67) being engaged with the groove (34, 64) so that the sliding member (30, 60) is moved upon a pivoting movement of the cam lever (51, 65).

Fig. 1

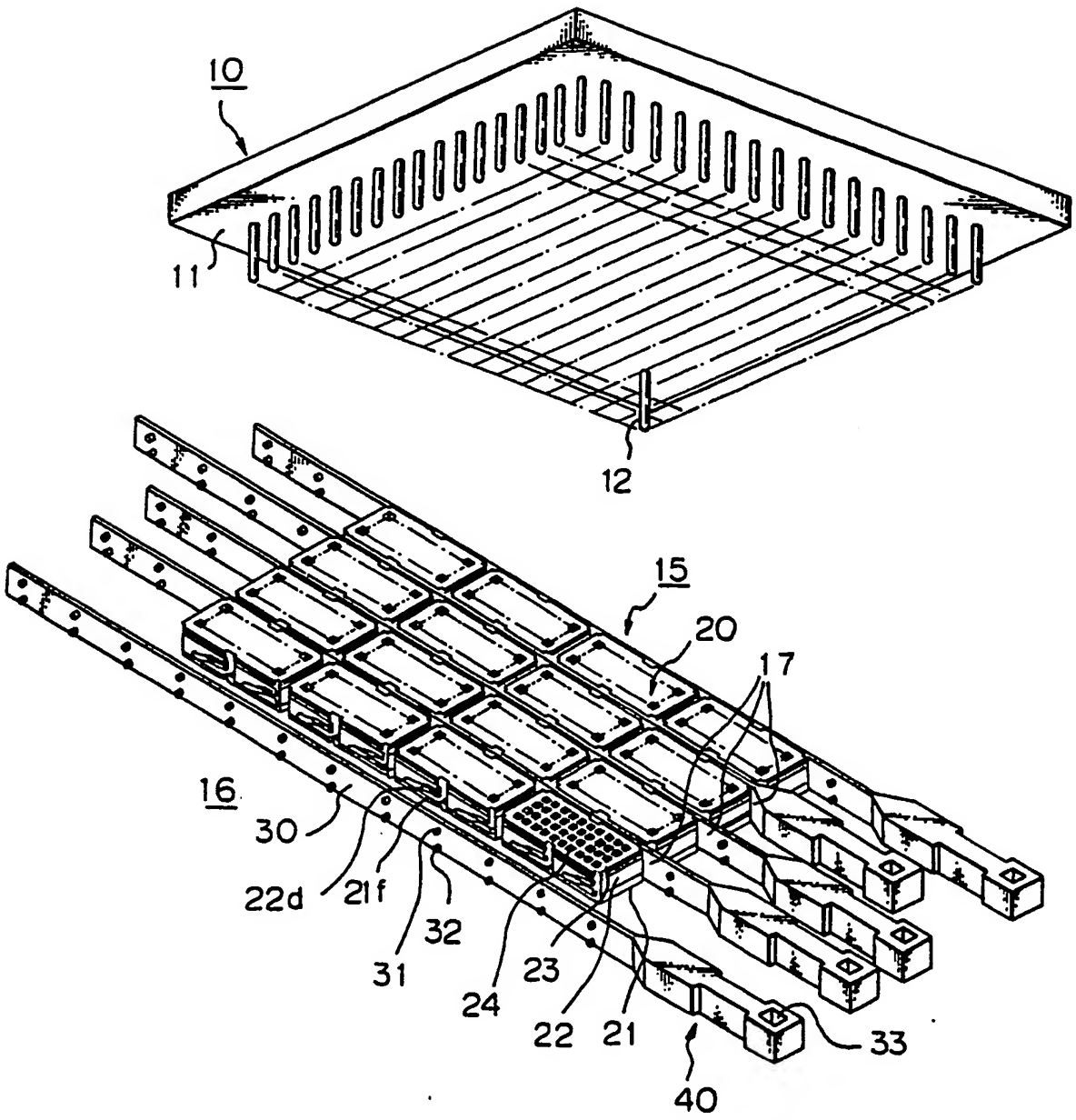


Fig. 2

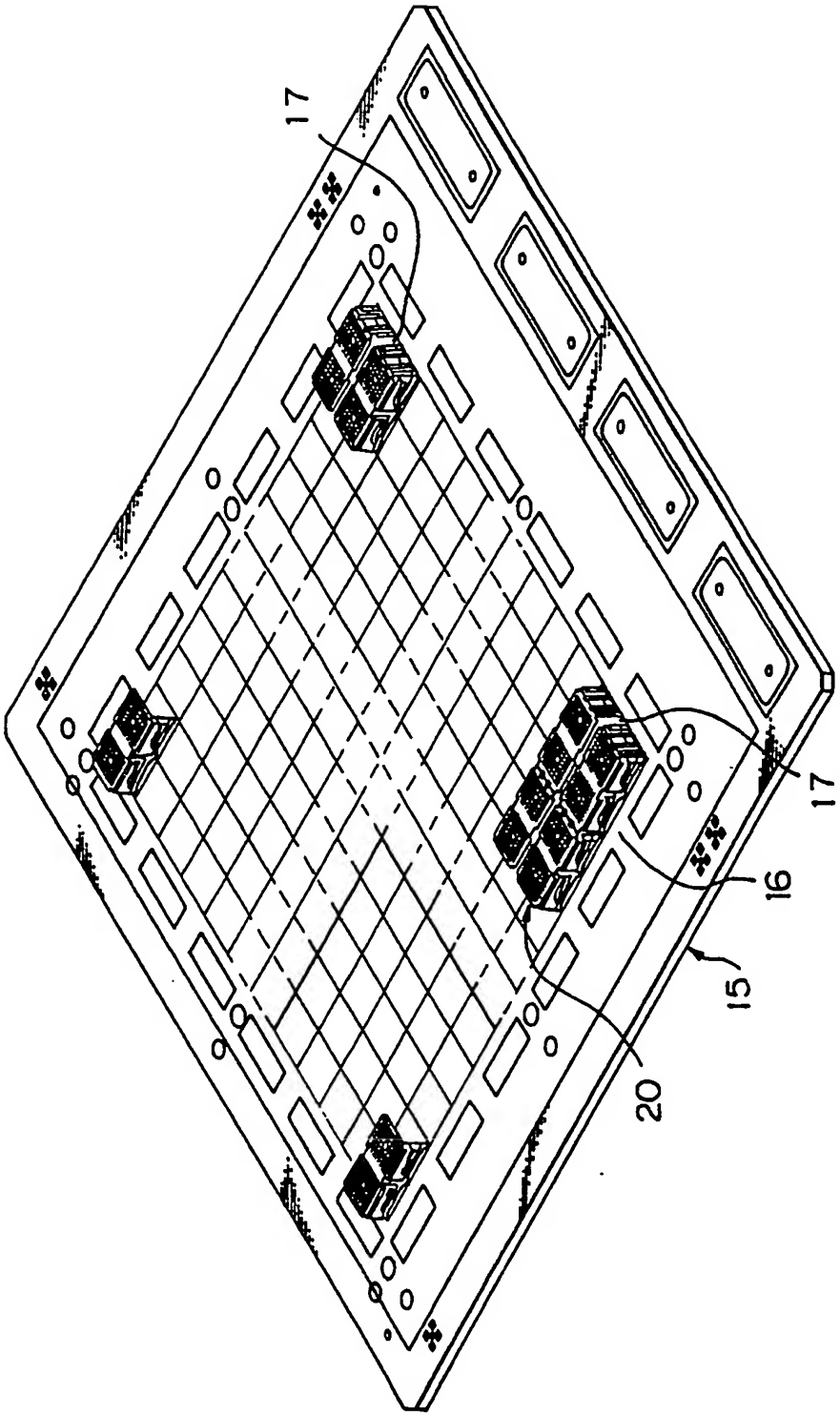
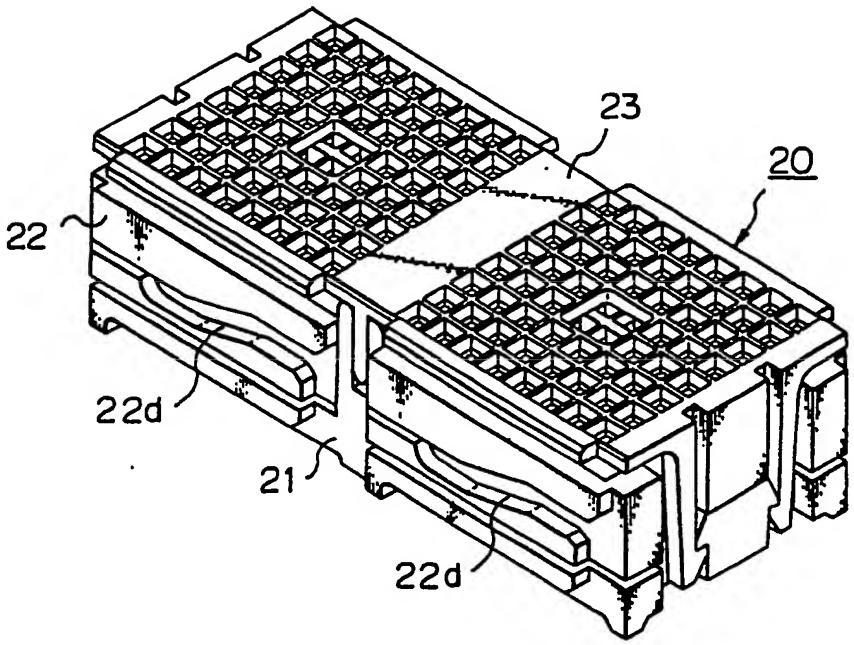


Fig. 3



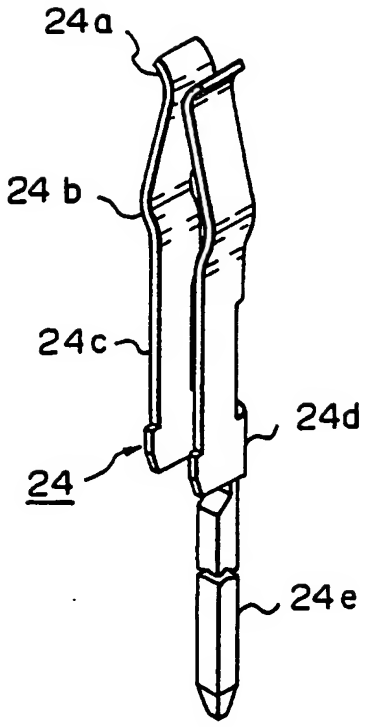
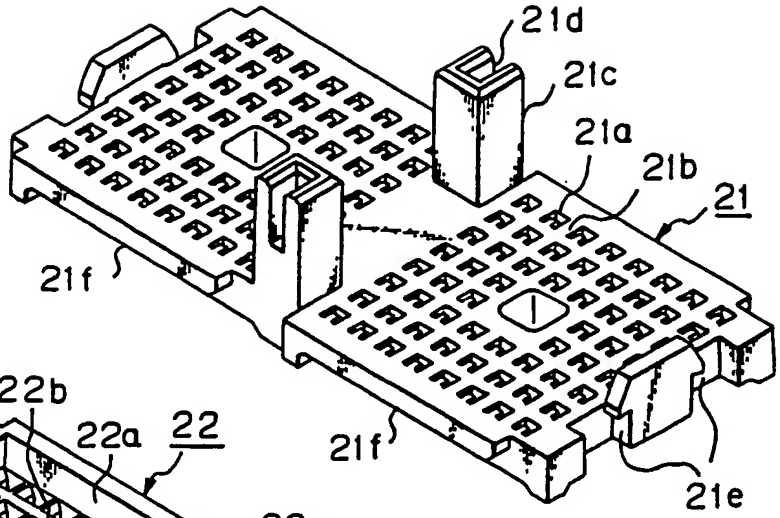


Fig. 4

Fig. 5A



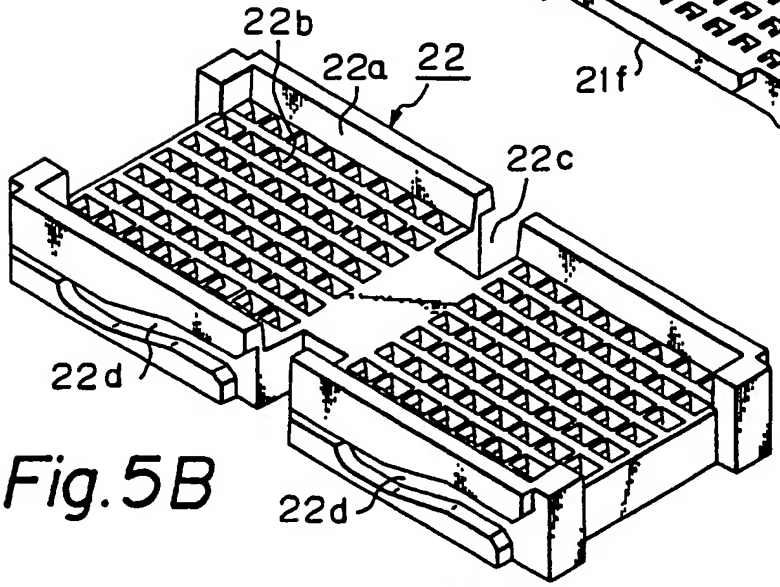


Fig. 5B

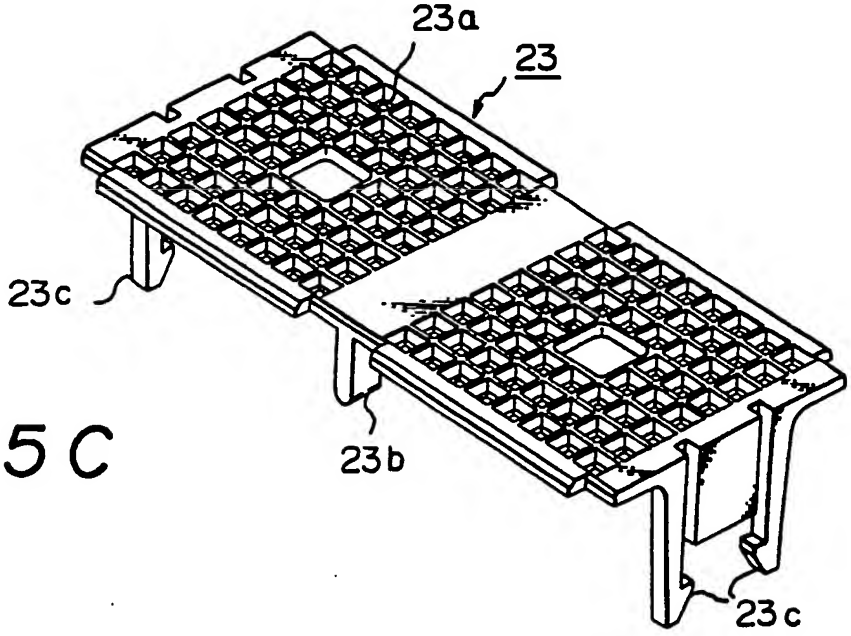
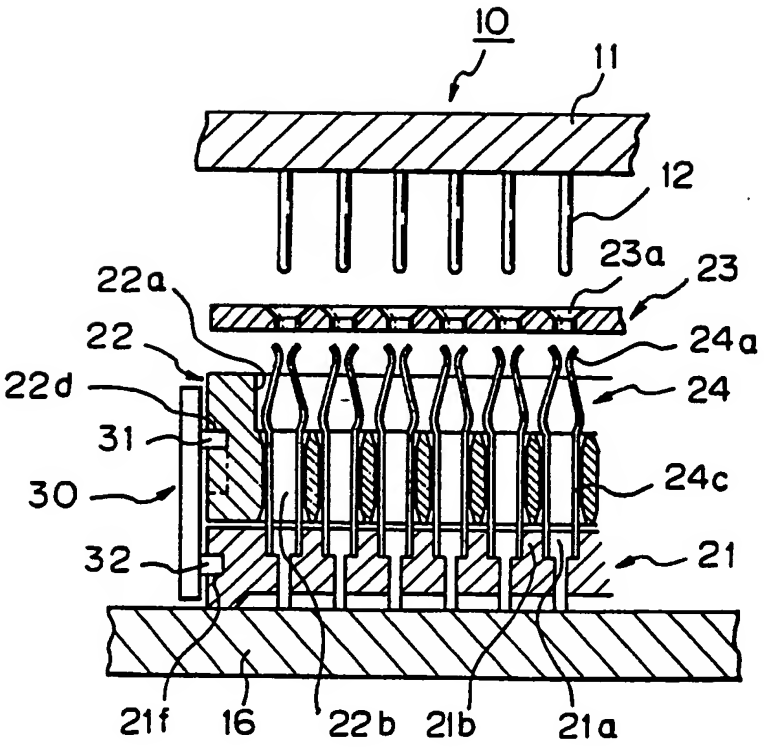


Fig. 5 C

Fig. 6



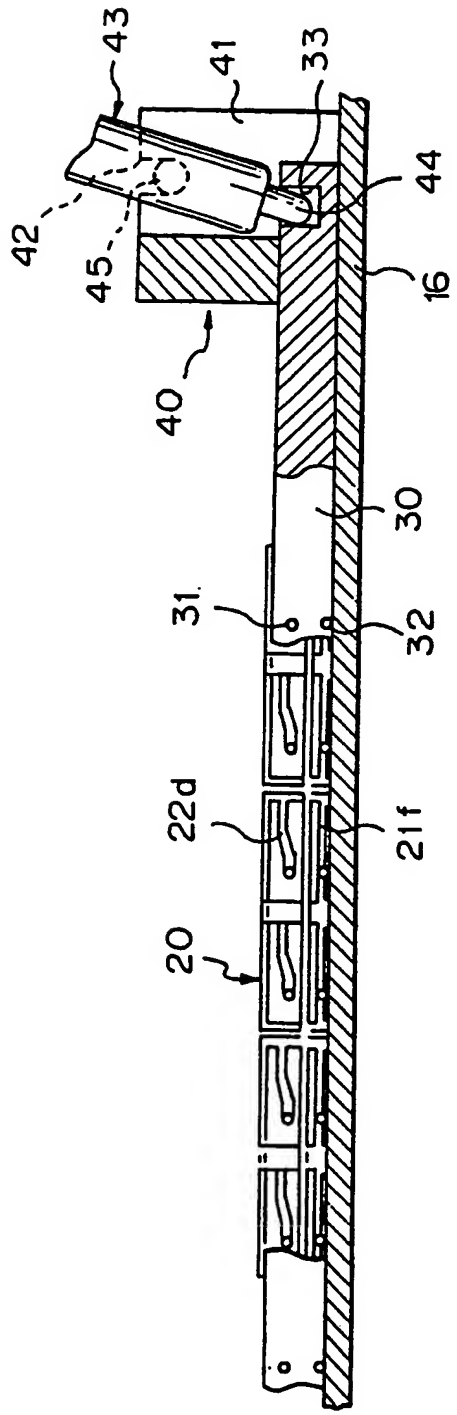


Fig. 7

Fig. 8A

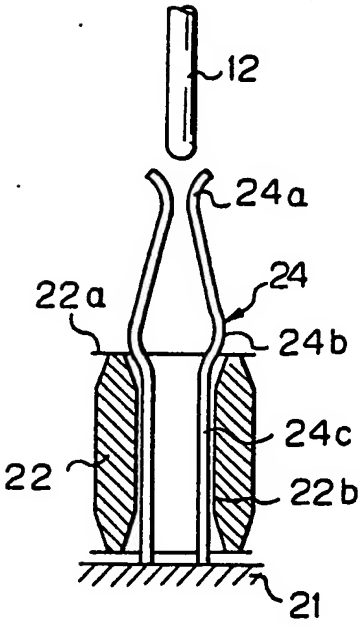


Fig. 8B

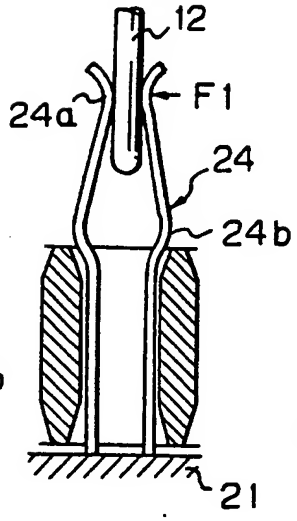


Fig. 8C

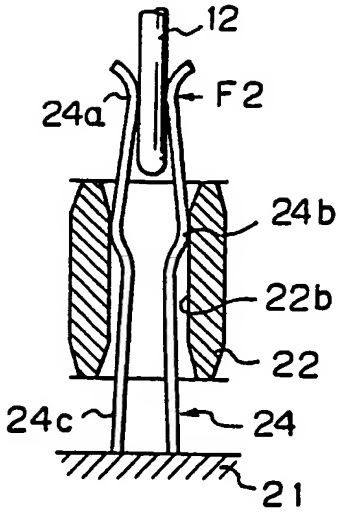


Fig. 9

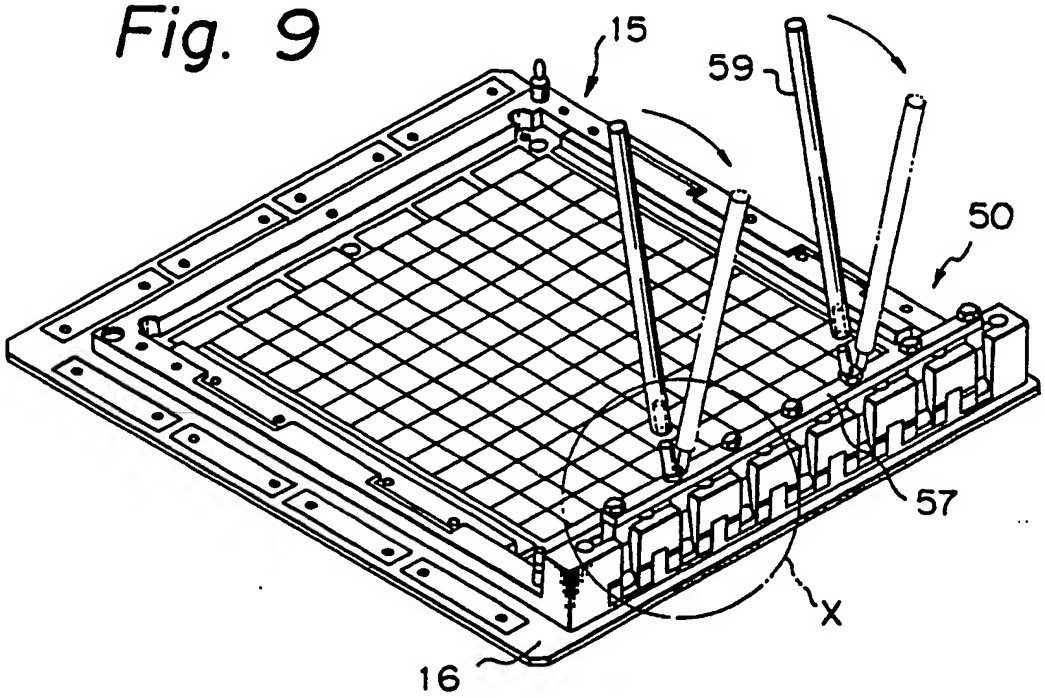


Fig. 10

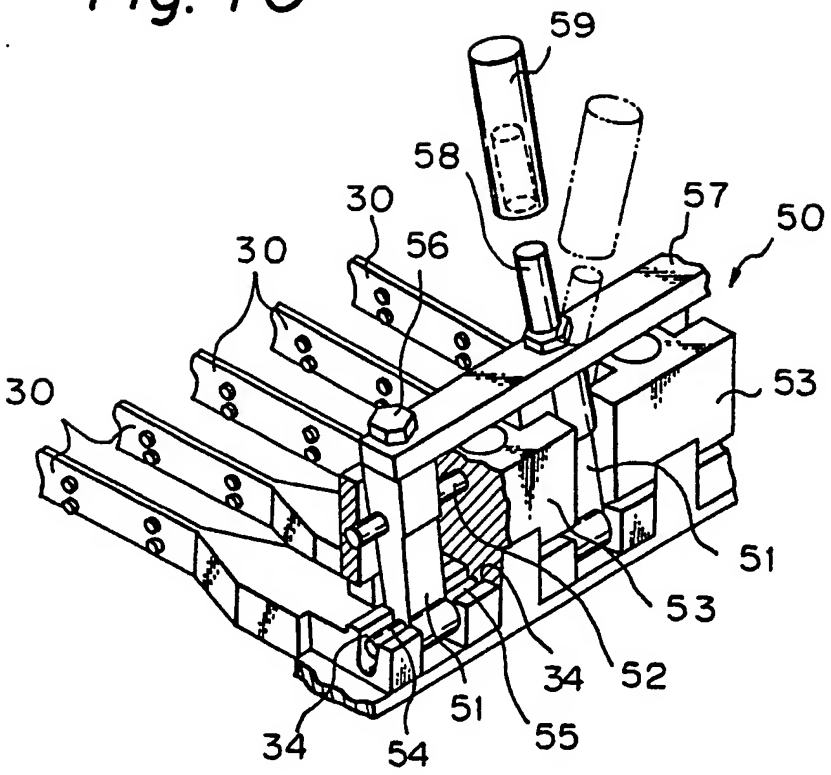
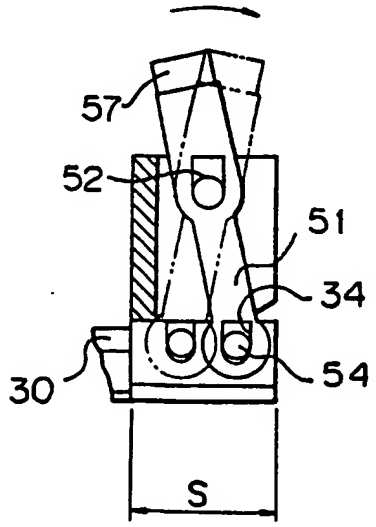


Fig. 11



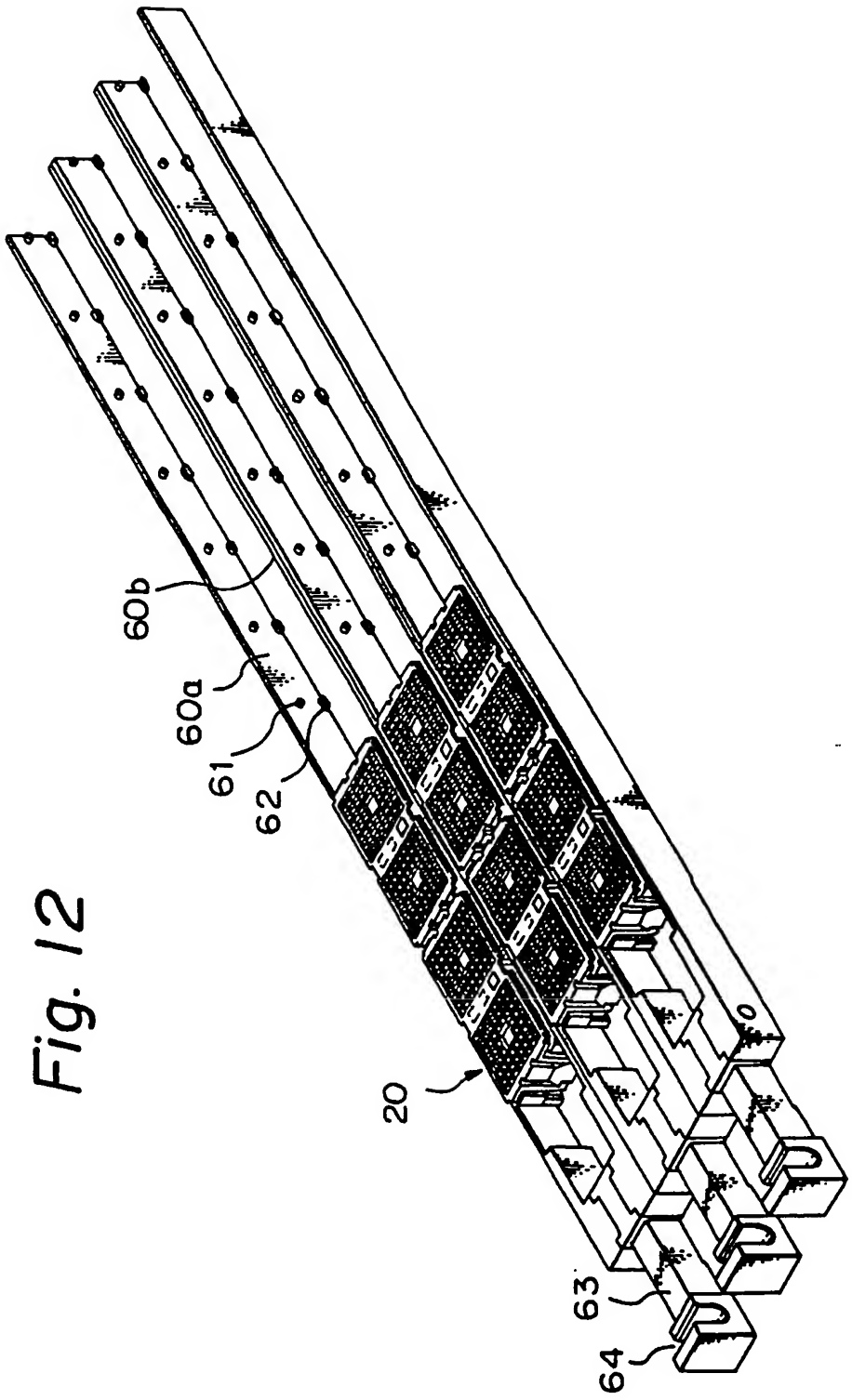


Fig. 12

Fig. 13

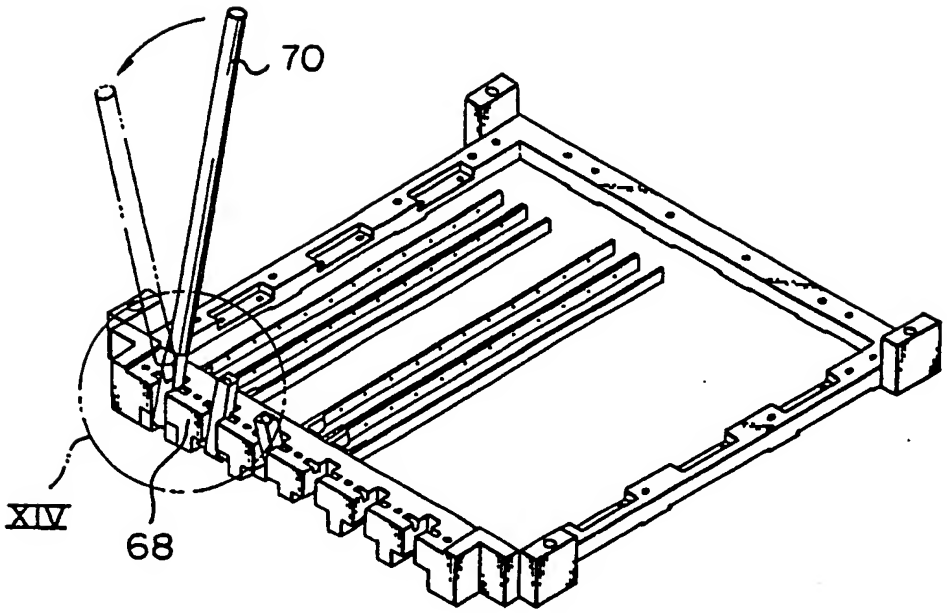
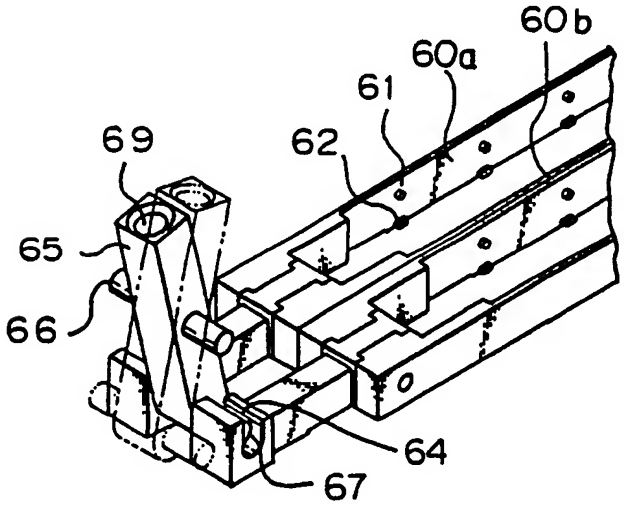


Fig. 14



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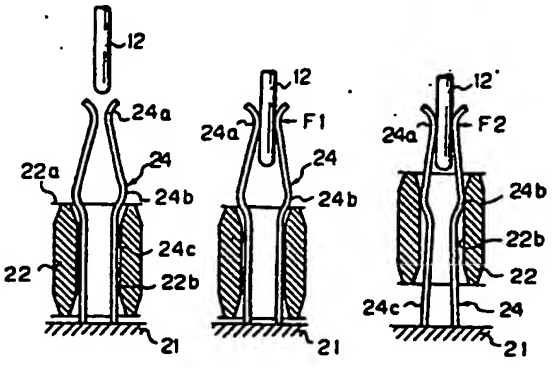
(54) **An electrical connector.**

(57) An electrical connector includes a plug (10) having a number of contact pins (12) and a jack (15) having a corresponding number of receptacle contacts (24). Each of the receptacle contacts (24) has a parallel portion (24c) and a widened portion (24b). A contact pressing member (22) having partition walls (22b) is movable so that when the contact pressing member (22) is in a first position (Figure 8A), the partition walls (22b) are positioned adjacent the parallel portions (24c) of the receptacle contacts (24) to allow an easy insertion of the contact pins (12) (Figure 8B) and, when the contact pressing member is moved to a second position (Figure 8C), the partition walls (22b) are moved to the widened portions (24b) of the receptacle contacts (24) so that they urge the widened portions (22b) together and, therefore, the receptacle contacts (24) are pressed into tight contact with the contact pins (12).

Fig. 8A Fig. 8B Fig. 8C



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EUROPEAN SEARCH REPORT

Application Number

EP 87 31 1297

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-4 478 472 (BAAR) * figures 1-12; column 3, line 53 - column 8, line 5 *	1-12	H 01 R 13/193 H 05 K 7/10
A	EP-A-0 168 922 (TRW) * figures 1-14; page 5, line 23 - page 19, line 11 *	1-12	
A	DE-A-2 733 934 (BURNDY) * figures 2-5; page 9, line 21 - page 13, line 17 *	1-12	
A	GB-A-2 083 298 (AUGAT) * figures 1-6; page 2, line 40 - page 4, line 56 *	1-12	
A	IBM TECHNICAL DISCLOSURE BULLETIN vol. 22, no. 5, October 1979, page 1936, New York, US; E. PENACHO et al.:"Arrangement for detachably contacting modules and circuit boards." * whole document *	1-12	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

H 01 R 13/00
H 01 R 23/00
H 05 K 7/10

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	01-03-1989	HAHN G

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